

ROOF MIRROR ASSEMBLY

[0001] This application is a continuation-in-part of Application Serial No. 09/894,207, filed June 28, 2001, pending, which application is hereby incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

[0002] This invention relates to the field of retroreflectors, and more particularly, to lateral transfer retroreflectors and roof mirror assemblies.

[0003] Retroreflectors generally have the property of causing incident and reflected light rays to travel along parallel paths. To achieve this parallelism, a retroreflector normally consists of three optically flat reflecting surfaces, each reflecting surface positioned at a right angle to each of the other reflecting surfaces. Any departure of the reflecting surfaces from their perpendicular orientation will cause the incident and reflected light rays to depart from parallel.

[0004] Retroreflectors lose accuracy when they are exposed to external stresses. Examples of such external stresses are mass, thermal expansion or contraction of the substrate material from which the retroreflector is made, or deflection caused by curing of the adhesives which join members of the retroreflector.

[0005] A roof mirror assembly is an optical assembly consisting of two mirror panels having their reflective surfaces arranged at substantially right angles to each other. Often, a roof mirror is used in association with another single mirror panel offset from the roof mirror assembly. In such a configuration, the reflective surface of the single mirror panel is arranged to be at a substantially right angle to each of the reflective surfaces of the roof mirror assembly. Such an overall optical device is normally called a lateral transfer retroreflector because the three substantially perpendicular reflective surfaces of the three mirror panels (two from the roof mirror and the one, single panel) are essentially arranged in the formation of a retroreflector assembly, but with one of the mirror panels (the single panel) of the retroreflector assembly offset a lateral distance from the other two mirror panels (the roof mirror).

[0006] Accordingly, there has been significant development of retroreflectors/roof mirrors/lateral transfer retroreflectors that focus on the precision of the alignment of the reflective panels of these assemblies, so as to achieve the greatest degree of parallelism possible of the incident and reflected rays. When striving to construct a very accurate retroreflector/roof mirror/lateral

transfer retroreflector assembly, attention will be given to reducing the external stresses that cause deflection of the reflective surfaces of the individual mirror panels upon joining the mirror panels together. Examples of such external stresses are mass, thermal expansion or contraction of the substrate material from which the mirror panels are made, or deflection caused by curing of the adhesives which join the mirror panels together or adhere the mirror panels to their supporting members.

[0007] Examples of some of these prior art retroreflectors, roof mirror assemblies and lateral transfer retroreflectors, are:

[0008] U.S. Pat. No. 3,977,765 to Morton S. Lipkins, which disclosed a retroreflector mounted to a support structure through means of applying a small amount of adhesive into the joints formed between joined members of the retroreflector and to a flat surface of the support structure.

[0009] U.S. Pat. No. 4,065,204, also to Morton S. Lipkins, which disclosed a lateral transfer retroreflector consisting of a base, a roof reflector having two reflecting plates and a third reflector. The base acts as an extension of the third reflector by attaching the third reflector to the roof reflector in the manner known to retroreflectors to produce the lateral transfer retroreflector construction.

[0010] U.S. Pat. No. 5,024,514 to Zvi Bleier and Morton S. Lipkins, which disclosed a lateral transfer retroreflector having a roof mirror of a particular construction and attached to the underlying lateral transfer member through use of three co-planar mounting pads.

[0011] U.S. Pat. No. 5,361,171 to Zvi Bleier, disclosed a lateral transfer retroreflector having a particular and different roof mirror construction than that shown in the '514 patent.

[0012] It would be desirable to provide a high-accuracy lateral transfer retroreflector that is off-the-shelf adjustable as to the displaced length between the mirror panel and the roof mirror and also having a less temperature-deviant assembly and mounting of the roof mirror and mirror panel.

[0013] It would be further desirable to provide still further constructions for a high-accuracy roof mirror assembly to be used in lateral transfer retroreflector assemblies and other optical assemblies, whereby the roof mirror assembly is a separately constructed and assembled unit that maintains the reflective surfaces of its two mirror panels in as near perpendicular orientation as possible, while allowing assembly of this roof mirror assembly to such other structure without substantially affecting the alignment of the reflective panels of the roof mirror assembly.

SUMMARY OF THE INVENTION

[0014] In accordance with the invention, an improved roof mirror assembly is provided. The roof mirror assembly of the invention is comprised of first and second mirror panels comprising first and second reflective surfaces and first and second mounting surfaces, respectively, the first and second mirror panels being joined together so that the first and second reflective surfaces are substantially perpendicular to each other. The assembly further comprising at least one mounting block comprising at least one opening extending through a portion thereof and at least one mounting pin received within the at least one opening of the at least one mounting block, wherein the at least one mounting pin is attached within the opening to the at least one mounting block and is attached to at least one of the first or second mounting surfaces of the first or second mirror panels. In an embodiment not having the mounting pins, the mirror panels each comprise first and second ends, wherein the first ends of the mirror panels are proximate to each other and the second ends of the mirror panels are proximate to each other when the mirror panels are in their joined condition, and the at least one mounting block is attached to the first ends of the mirror panels, and the assembly is mounted onto another structure along a bottom surface of the at least one mounting block.

[0015] In addition, the roof mirror assembly and the mirror panel mounting are, in a preferred embodiment, kinematic structures that are also improvements over earlier constructions. In particular, the roof mirror assembly of the subject invention has, in a preferred, but not required, embodiment, at least a pair of mounting blocks that act also as back supports and are located substantially at opposite ends of the roof mirror. However, the invention also anticipates the roof mirror assembly having only at least one mounting member. The manner of attachment of the mounting blocks to the back portions of the mirror panels making up the roof mirror assembly, is such that expansion and contraction of the reflective surfaces of the mirror panels of the roof mirror assembly will be in a direction substantially perpendicular to the direction of the roof angle axis. Deflection in this direction helps to minimize displacement (error) of the transmitted light beam traveling through the lateral transfer retroreflector. Similarly, the mounting of the mirror panel to the mirror panel housing by means of substantially 45° chamfered edges, insures that the forces exerted by thermal expansion or contraction of the bonding material situated along those chamfered edges, will have a canceling effect, and not deflect the reflective surface of the mirror panel.

[0016] Accordingly, it is an object of the present invention to provide an improved lateral transfer retroreflector assembly and an improved roof mirror assembly.

[0017] Still another object of the invention is to provide a lateral transfer retroreflector assembly having a component construction capable of allowing for off-the-shelf customization for different customer needs based upon differing customer specifications.

[0018] Yet a further object of the invention is to provide a lateral transfer retroreflector assembly having a roof mirror assembly construction and mounting such that deformations in the reflective surfaces of the mirror panels of the roof mirror assembly due to thermal expansion/contraction are minimized in the direction of the roof angle axis.

[0019] A still further object of the invention is to provide a lateral transfer retroreflector assembly, wherein the deflective forces exerted on the mirror panel by thermal expansion or contraction of the joint bonding the mirror panel to the mirror panel housing, are minimized.

[0020] Other objects of the invention will in part be obvious and will in part be apparent from the following description taken in association with the figures.

[0021] The invention accordingly comprises an assembly possessing the features, properties and relation of components which will be exemplified in the products hereinafter described, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] For a fuller understanding of the invention, reference is made to the following description taken in connection with the accompanying drawings, in which:

[0023] **FIG. 1** is a perspective view of a lateral transfer retroreflector assembly made in accordance with the invention;

[0024] **FIG. 2** is a cross-sectional view taken along line 2-2 of **FIG 1**;

[0025] **FIG. 3** is a perspective view of the mirror panel of the invention;

[0026] **FIG. 4** is a left side elevational view of the mirror panel housing of the invention;

[0027] **FIG. 4A** is a partial perspective view of the mounting pad of member 26 of the mirror panel housing;

[0028] **FIG. 4B** is a partial perspective view of the mounting pad of member 24 of the mirror panel housing;

[0029] **FIG. 5** is a right side elevational view of the mirror panel housing;

[0030] **FIG. 6** is a cross-sectional view taken along line 6-6 of **FIG. 5**;

[0031] **FIG. 7** is a left side elevational view of the mirror panel housing;

[0032] **FIG. 8** is a cross-sectional view taken along line 8-8 of **FIG. 7**;

[0033] **FIG. 9** is a perspective view of a roof mirror assembly made in accordance with the subject invention;

[0034] **FIG. 10** is an elevational view of one end of the roof mirror assembly of **FIG. 9**;

[0035] **FIG. 11** is an elevational view of the other end of the roof mirror assembly of **FIG. 9**;

[0036] **FIG. 12** is a bottom plan view of the roof mirror assembly of **FIG. 9**;

[0037] **FIG. 13** is a perspective view of another embodiment of a roof mirror assembly made in accordance with the subject invention;

[0038] **FIG. 14** is an exploded perspective view of yet another embodiment of a roof mirror assembly made in accordance with the subject invention;

[0039] **FIGs. 15A and B** are a perspective views of the assembled roof mirror of **FIG. 14**, from opposite directions;

[0040] **FIG. 16** is an exploded perspective view of still another embodiment of a roof mirror assembly made in accordance with the subject invention;

[0041] **FIG. 17** is a bottom perspective view of the assembled roof mirror of **FIG. 16**; and

[0042] **FIG. 18** is an elevational view of one end of a further embodiment of a roof mirror assembly made in accordance with the subject invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0043] Referring to **FIG. 1**, a lateral transfer retroreflector assembly made in accordance with the invention and generally designated at **10**, is illustrated. Lateral Transfer Retroreflector ("LTR") **10** comprises three components; a mirror panel housing **20**, a roof mirror assembly housing **60** and a connecting member **90**, having a thickness **92**.

[0044] As seen in **FIGs. 1 and 4**, mirror panel housing **20** is comprised of first and second side members **24** and **26**, as well as receiving member **28**, for receiving connecting member **90**. Housing **20** can also include member **30**, to lend extra stability to the structure, as well as aperture receiving member **22**, having aperture **32** extending therethrough. Aperture **32** can be of any geometric configuration, the preferred configurations being in the circle and square families. Aperture **32** has a first end **33** and a second end **35**, the distance between which will help dictate the inside diameter of connecting member **90**. It is to be understood herein that member **90** does not have to be circular in cross section, but could be of other shapes; particularly square. However,

since light beams to be passed through LTR 10 are normally themselves circular in cross section, the preferred embodiment shown in the figures and discussed herein, will regard a circular aperture 32 and a circular tubular member 90.

[0045] Continuing with the above discussion, the dimensional congruity between the size of aperture 32 and the cross sectional diameter of member 90 will insure that a light beam passing through LTR 10 will propagate through member 90 very close to the inside surface of member 90 as the beam approaches either of ends 33 or 35 of aperture 32.

[0046] It is also seen in FIGs. 1 and 2 that roof mirror assembly housing 60 is comprised of side members 64 and 66, receiving member 68, as well as a top member 62. Receiving members 28 of mirror panel housing 20 and 68 of roof mirror assembly housing 60, receive connecting member 90 to join housings 20 and 60 into a complete lateral transfer retroreflector assembly 10.

[0047] Turning now to FIG. 3, mirror panel 34 to be used with LTR 10 is shown. Mirror panel 34 has a reflective surface 40, and two chamfered edges 36 and 38. As seen in FIG. 1, mirror panel 34 is adhered to mirror panel housing 20 in such a manner as to be oriented with its reflective surface 40 below, and in reflective relation with, aperture 32 and member 90. In practice, and as will be discussed in more detail below, the light beam, if it is entering LTR 10 through aperture 32, will then reflect off of reflective surface 40 of mirror panel 34, and propagate through member 90 into roof mirror assembly housing 60, where it will reflect off of reflective surfaces 104 and 114 of roof mirror assembly 100 to propagate back toward the source of the beam, in a direction substantially parallel to the beam's incident direction, but at a displaced distance, substantially based upon the length of member 90.

[0048] Continuing with FIGs 3-8, it is seen that mirror panel 34 is adhered at three contact surfaces to corresponding mounting pads 21, 23, and 25 of edge portions 27 and 29 of first and second side members 24 and 26, respectively. In particular, edge portions of 27 and 29, and their corresponding mounting pads 21, 23 and 25, onto which mirror panel 34 is adhered, are themselves chamfered, as is best seen in FIGs 4A and 4B. The construction and mounting of mirror panel 34 of the subject invention is different to that of the prior art in U.S. Patent Nos. 5,024,514 and 5,361,171 (discussed earlier herein), in that the subject connection between mirror panel 34 and mirror panel housing 20 is chamfered surface to chamfered surface, as opposed to the prior art disclosure of mounting pads oriented perpendicularly to the reflective surface. What is similar, however, between the subject connection of mirror panel 34, and the prior art connections, is the adhesion of mirror

panel 34 to mirror panel housing 20 at only three distinct areas; two areas along chamfered surface 38 and only one area along chamfered surface 36. The use of the matching chamfered surfaces 36/38 and 21/23 and 25 helps to reduce the distortional effect of the connection of mirror panel 34 to mirror panel housing 20, as well as to help reduce stresses caused by thermal expansion/contraction, as the substantially 45° of the chamfers insures that such distortional forces do not distort rereflective surface 40 in a way to effect the orientation of the beam passing through LTR 10.

[0049] Turning now to a discussion of a first embodiment of a roof mirror assembly of the invention, attention is first directed to roof mirror assembly 100 of FIGs 9-12. Roof mirror assembly 100 comprises a pair of mirror panels 102 and 112, and a pair of mounting blocks 140 and 160, although the invention does not anticipate a fixed number of mounting blocks, so long as at least one such mounting block exists.

[0050] Mirror panels 102 and 112 have reflective surfaces 104 and 114, respectively, which reflective surfaces are in reflective relation with reflective surface 40 of mirror panel 34, as well as member 90 and aperture 32, when roof mirror assembly 100 is secured within roof mirror housing 60 of LTR 10. Each of mirror panels 102 and 112 also has a back portion 116 and 106, respectively. In particular, reflective surface 104 is substantially perpendicularly oriented to reflective surface 114, and reflective surface 40 is itself oriented substantially perpendicularly to both reflective surfaces 104 and 114. This mutually perpendicular orientation of the three reflective surfaces of LTR 10 essentially duplicates the construction of a standard HollowTM retroreflector as is known in the art, except that reflective surface 40 is offset a distance from reflective surfaces 104 and 114.

[0051] Continuing with the roof mirror assembly embodiment of FIGs 9-11, mirror panels 102 and 112 are seen to be adhered together at joint 110. In a preferred embodiment, this joining together is achieved through a miter joint connection, although other manners of joining the two panels are anticipated herein as are known in the art and, for example, as is shown in the embodiment of Fig. 16, so long as reflective surfaces 104 and 114 are substantially perpendicular to each other. In order to create miter joint 110, the attachment surfaces of mirror panels 102 and 112 which are joined together to create miter joint 110, are at substantially 45 degree angles to reflective surfaces 104 and 114. Such a dual 45 degree angle connection between these two surfaces results in the perpendicularity between reflective surfaces 104 and 114, and helps to provide the associated reduction in distortive forces to the optical flatness of the reflective surfaces, as earlier discussed.

[0052] Continuing with a discussion of FIGs 9-11, it is seen that connected together panels

102 and **112** are finally formed into a secure roof mirror assembly through the mounting thereto, against back portions **106** and **116**, of mounting blocks **140** and **160**. While the preferred embodiment is for use of a pair of mounting blocks, the invention anticipates that so long as at least one mounting block is used, the inventive results are achieved. However, in so mounting panels **102** and **112** to blocks **140** and **160** as shown in the embodiment of FIGs 9-12, air gaps **150**, **152**, **154** and **156** are created. Air gap **150** is between surface **146** of mounting block **140** and surface **116** of panel **112**. Air gap **152** is between surface **144** of mounting block **140** and surface **106** of panel **102**. Air gap **154** is between surface **166** of mounting block **160** and surface **106** of panel **102**. Air gap **156** is between surface **164** of mounting block **160** and surface **116** of panel **112**. (See, FIGs. 10 and 11).

[0053] As is further seen in FIGs 9-12, back portions **106** and **116** of panels **102** and **112**, can have protruding elements **120** and **130**, which protrude, in a preferred embodiment, in a direction generally away from reflective surfaces **104/114**, respectively, although other protrusion directions are anticipated by the invention. In particular, as the primary purpose of the protruding elements is to provide receiving surfaces for attaching the mounting block(s) to the back portions of the mirror panels, so long as such receiving surfaces are created, the overall shape and protruding direction of the protruding elements is not important. In particular, as is best seen in FIG. 9 as regards mirror panel **112**, protruding element **120** extends from back portion **116** and mounting blocks **140** and **160** are attached thereto (preferably through use of some type of adhesive) along surfaces **142** and **162**, respectively. As is best seen in FIGs 10 and 11, surface **142** is attached to receiving surface **108** for mirror panel **102** and to receiving surface **118** for mirror panel **112**, while surface **162** is attached to receiving surface **128** for mirror panel **102** and to receiving surface **138** for mirror panel **112**. Each of these receiving surfaces for this embodiment of the inventive roof mirror construction are aligned in a substantially perpendicular plane to the plane of the corresponding reflective surface for that receiving surface's mirror panel. For example, receiving surfaces **108** and **128** of protruding element **130** of mirror panel **102** lie in planes that are substantially perpendicular to a plane corresponding to reflective surface **104**, while receiving surfaces **118** and **138** of protruding element **120** of mirror panel **112** lie in planes that are substantially perpendicular to a plane corresponding to reflective surface **114**. In addition, in this orientation, receiving surfaces **108**, **118**, **128** and **138** are also all substantially perpendicular to miter joint **110**. Such a construction helps to ensure that any substantial distortional effects due to thermal expansion/contraction of panels **102** and **112** and/or blocks **140** and **160** will be in a direction substantially perpendicular to a longitudinal axis for roof

mirror assembly **100**; i.e., perpendicular to the planes of reflective surfaces **104** and **114**.

[0054] Turning again to FIG 1, it is seen that roof mirror assembly **100** is secured to roof mirror assembly housing **60** by way of connection between bottom surfaces **141** and **161** of blocks **140** and **160** (see FIG. 12) to member **70** of housing **60**. Such a secure connection of roof mirror assembly **100** to housing **60** assists and strengthens the durability of LTR **10**.

[0055] Turning now to a discussion of FIG 13, another embodiment of the inventive roof mirror assembly is shown at **300**. Assembly **300** is constructed identically to that of assembly **100**, accept for the addition of back plate member **302**, adhered below mounting blocks **340** and **360**, to surfaces **341** and **361** (not shown).

[0056] Directing attention now to the embodiment of a roof mirror assembly as shown in FIGs 14 and 15A and B, roof mirror assembly **400** is provided. This assembly has first and second mirror panels **402** and **412**, having substantially perpendicular reflective surfaces **404** and **414**, respectively. Panels **402** and **412** further have back portions **406** and **416**, respectively. In this embodiment, back portions **406** and **416** can have corresponding protruding elements **430** and **420**. In a preferred, but not mandatory, construction, mirror panels **402** and **412** are adhered together at miter joint **410**, although other manners of joining the two surfaces are anticipated herein as are known in the art and, for example, as are seen in the embodiment of Fig. 16. In order to create miter joint **410**, the attachment surfaces of mirror panels **402** and **412** which are joined together to create miter joint **410**, are at substantially 45 degree angles to reflective surfaces **404** and **414**. Such a dual 45 degree angle connection between these two surfaces results in the perpendicularity between reflective surfaces **404** and **414**, and helps to provide the associated reduction in distortive forces to the optical flatness of the reflective surfaces, as earlier discussed.

[0057] Continuing with a discussion of FIGs 14 and 15, it is seen that connected together panels **402** and **412** are finally formed into a secure roof mirror assembly **400** through the mounting thereto, against back portions **406** and **416**, of mounting blocks **440** and **460**. While the preferred embodiment is for use of a pair of mounting blocks, the invention anticipates that so long as at least one mounting block is used, the inventive results are achieved.

[0058] As is further seen in FIGs 14 and 15, back portions **406** and **416** of panels **402** and **412**, have protruding elements **430** and **420**, respectively, which protrude, in a preferred embodiment, in a direction generally away from reflective surfaces **404/414**, respectively, although other protrusion directions are anticipated by the invention. In particular, as the primary purpose of

the protruding elements is to provide receiving surfaces for attaching the mounting block(s) to the back portions of the mirror panels, so long as such receiving surfaces are created, the overall shape and protruding direction of the protruding elements is not as important; although in this embodiment (as opposed to the embodiment of FIGs 9-12), portions of receiving surfaces **434** and **424** which, as will be discussed in more detail below, extend along a plane substantially parallel to a plane of its corresponding reflective surface for attachment to a portion of one of the mounting blocks, so that a little more weight is given in this embodiment to the overall shape and orientation of the protruding elements. In particular, as seen in FIG. 15A as regards mirror panel **412**, protruding element **420** extends from back portion **416** and mounting blocks **440** and **460** are attached thereto (preferably through use of some type of adhesive) along surfaces **442** and **464**, respectively, not surface **462** as would have been the case in the earlier discussed embodiment of FIGs 9-12. To achieve this construction, protruding element **420** is offset from a “centered” position extending from back portion **416**, so that it is able to be attached along its substantially perpendicularly running receiving surface **422** to surface **442** of mounting block **440**, while surface **464** of mounting block **460** is attached to substantially parallel running receiving surface **424** of protruding element **420**. In like fashion, and as seen best in FIG. 15B, protruding element **430** is offset from a “centered” position extending from back portion **406**, so that it is able to be attached along its substantially perpendicularly running receiving surface **432** to surface **462** of mounting block **460**, while surface **444** of mounting block **440** is attached to substantially parallel running receiving surface **434** of protruding element **430**.

[0059] As with the earlier embodiment of FIGs 9-12, roof mirror assembly **400** is secured to roof mirror assembly housing **60** by way of connection between bottom surfaces **441** and **461** of blocks **440** and **460** (see FIG. 14) to member **70** of housing **60**. Such a secure connection of roof mirror assembly **400** to housing **60** helps to assist and strengthen the durability of LTR **10**. Further, a back plate member (not shown) similar in construction and purpose to member **302** of FIG. 13 would also be available for the roof mirror assembly of this embodiment.

[0060] Directing attention now to the embodiment of a roof mirror assembly as shown in FIGs 16 and 17, roof mirror assembly **500** is provided. This assembly has first and second mirror panels **502** and **512**, having substantially perpendicular reflective surfaces **504** and **514**, respectively. Panels **502** and **512** further have back portions **506** and **516**, respectively. In this embodiment, back portions **506** and **516** have corresponding protruding elements **530** and **520**. In a preferred, but not

mandatory, construction, mirror panels **502** and **512** are adhered together at **510**, this joining together being achieved through a miter joint connection similar in construction to the earlier embodiments discussed herein, or through some other known manner of so attaching mirror panels or through the overlap connection shown in FIG. 16. The overlap connection of FIG. 16 is achieved simply by having at least a portion of an edge of one of the mirror panels attached to a portion of the reflective surface of the other mirror panel, or some equivalent surface portion of the other mirror panel (for example, it is possible that the optically reflective surface of the mirror panel does not extend completely over the corresponding surface of the panel so that a small strip of the surface remains non-optically reflective and the edge of the other panel is attached along this small strip of surface).

[0061] Continuing with a discussion of FIGs 16 and 17, it is seen that connected together panels **502** and **512** are finally formed into a secure roof mirror assembly **500** through the mounting thereto, against back portions **506** and **516**, of mounting blocks **540** and **560**. While the preferred embodiment is for use of a pair of mounting blocks, the invention anticipates that so long as at least one mounting block is used, the inventive results are achieved.

[0062] As is further seen in FIGs 16 and 17, back portions **506** and **516** of panels **502** and **512**, have protruding elements **530** and **520**, respectively, which protrude, in a preferred embodiment, in a direction generally away from reflective surfaces **504/514**, respectively, creating receiving surfaces **532/534** and **522/524**, respectively, although other protrusion directions are anticipated by the invention. In particular, as the primary purpose of the protruding elements is to provide receiving surfaces for attaching the mounting block(s) to the back portions of the mirror panels, so long as such receiving surfaces are created, the overall shape and protruding direction of the protruding elements is not as important.

[0063] In this embodiment of the roof mirror assembly, mounting blocks **540** and **560** are attached to protruding elements **530** and **520** through openings in the mounting blocks and mounting pins **550** attached within the openings and also attached to the protruding elements' receiving surfaces. In particular, in the particular embodiment of the roof mirror shown in FIGs 16 and 17, each mounting block has two openings extending therethrough; openings **542** and **544** for mounting block **540**, and openings **562** and **564** for mounting block **560**. For this embodiment, through each of these openings is received a mounting pin **550**, which pins are shown in the figures as having a circular cross-section, but it is understood that any cross-section is anticipated by the invention.

The pins are adhered within the openings and their ends **552** are adhered to their respective receiving surfaces, as is best seen in FIG. 17. It is also to be understood that the number of openings, and therefore the number of corresponding pins, can vary, depending on the size of the roof mirror assembly.

[0064] As with the earlier embodiment of FIGs 9-12, roof mirror assembly **500** is secured to roof mirror assembly housing **60** by way of connection between bottom surfaces **541** and **561** of blocks **540** and **560** (see FIG. 16) to member **70** of housing **60**. Such a secure connection of roof mirror assembly **500** to housing **60** helps to assist and strengthen the durability of LTR **10**. Further, and as an alternate manner of attaching assembly **500** to housing **60**, in addition to mounting blocks **540** and **560** there can exist an optional mounting block connecting element **580**. This element is preferably, but not mandatorily, made of the same material as the mounting blocks so as to reduce differences in the coefficient of expansion/contraction, and is attached under the mounting blocks along surfaces **541** and **561** and then the bottom surface **581** of element **580** is attached to roof mirror assembly housing **60**, in a manner substantially similar to member **302** of Fig. 13.

[0065] Finally, FIG. 18 is directed to another embodiment of the invention. In this construction, roof mirror assembly **600** is comprised of mirror panels **602** and **612**, having substantially perpendicular reflective surfaces **604** and **614**, respectively, and being joined at miter joint **610**. Miter joint **610** is formed and functions in the same manner as the earlier discussed miter joints **110** and **410**, and is also able to be substituted therefore by another type of connection between the mirror panels known in the art (as for example, the overlapping connection shown in FIG. 16). The distinction between the embodiment of FIG. 18 and the other embodiments already discussed is that mounting block **660**, is not attached to back portions of panels **602** and **612**, but is instead attached to ends **608** and **618** along narrow areas of contact, as seen at **H**. For those situations when a second block assembly is required, a similar construction is found at the other end of assembly **600**, but is not shown herein. Accordingly, this end-mounted block construction is an alternate construction for all of the assemblies already discussed herein.

[0066] As with the earlier embodiments, roof mirror assembly **600** is secured to roof mirror assembly housing **60** by way of connection between bottom surfaces of the mounting block(s) (for example, bottom surface **661**) to member **70** of housing **60**. Such a secure connection of roof mirror assembly **600** to housing **60** helps to assist and strengthen the durability of LTR **10**. Further, and as an alternate manner of attaching assembly **600** to housing **60**, in addition to the mounting blocks

there can exist an optional back plate member (similar to that found at **302**, not shown in this embodiment), adhered below the mounting block(s) to the bottom surfaces (for example, **661**). Such an element would preferably be made of the same material as the mounting blocks so as to reduce differences in the coefficient of expansion/contraction.

[0067] The end-mounted block construction of FIG. 18 and back portion mounted block constructions of FIGs 9-17, allow for use of substantially all of the reflective surfaces of the mirror panels of the roof mirror assemblies, since these mounting blocks do not interfere in any way with the path of any light beam incident to or reflected from the roof mirror assemblies when the assemblies are in use. Accordingly, use of the roof mirror assemblies of the invention herein allows the effective length of the mirror panels to be greater than in past roof mirror constructions, which longer effective length could be important if these assemblies are used in otherwise small devices.

[0068] Regarding connecting member **90**, as has been stated, this member can be cut from an off-the-shelf member of standard construction and length. Such an off-the-shelf retro-fit of connecting member **90** allows one to stock separate quantities of housings **20** and **60**, and member **90**, for construction of an LTR **10** to meet any customer specifications, in a quick and cost affective manner.

[0069] It is also anticipated herein that the mounting pin construction of FIGs 16 and 17 could be upon mirror panel ends **508** and/or **518** (or for that matter, ends **608** and/or **618**, as shown in FIG. 18). In such a construction, mounting pins **550** would be attached to these ends of the mirror panels, as opposed to the receiving surfaces of the protruding elements.

[0070] Unless otherwise expressly indicated, when used throughout this document the term “substantially” shall have the meaning of “approximation”, not “magnitude”; i.e., it shall have the meaning, “being largely but not wholly that which is specified.” See, Webster’s Ninth New Collegiate Dictionary, Merriam-Webster Inc., 1989.

[0071] Further, unless otherwise expressly indicated, when used throughout this document the term “block” is not meant to be restricted to a standard rectangularly shaped member, but is meant to cover a broad range of shapes having a broad range of integrities, as for example, solid, hollow, partially solid, etc. In addition, various constructions of the mounting block are anticipated herein.

[0072] It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and, since certain changes may be made in the

above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

[0073] It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language might be said to fall therebetween.